SD11
.U524
No. 121

United States
Department of
Agriculture

Forest Service

R10-TP-121

September 2003

Weeds

The Silent Invaders

A USDA Forest Service Report on Invasive Plants

USDA Forest Service photo by Michael Shephard.

Spotted knapweed, native of Eurasia, now covers over 1.5 million ha of pasture and rangeland in the interior west. It recently has been discovered in Southcentral Alaska.

Cover: clockwise from upper left.

Garlic mustard (upper midwest).
Nuzzo, Victoria, Natural Areas Consultants. image 0002044, invasive.org, August 24, 2003.

Common gorse (highlighting the spines).
Rees, Norman, USDA ARS. image 0021012, invasive.org, September 2, 2003.

Russian olive (eastern Oregon).
Powell, Dave, USDA Forest Service. image 121300, invasive.org, August 28, 2003.

Mimosa trees in flower (Alabama).
Miller, James, USDA Forest Service. image 0016008, invasive.org, August 28, 2003.

Canada thistle (Montana).
Ress, Norman, USDA ARS. image 0024019, invasive.org, August 28, 2003.

Center: Giant hogweed (North Carolina).
USDA APHIS, image 1148086, invasive.org, August 28, 2003.

Executive Summary

A challenge for the USDA Forest Service is controlling the spread of invasive plants (weeds). Weeds have a profound biological, economic, and social impact on U.S. forests and rangelands, and both their populations and control costs are growing exponentially. Some have been introduced into this country accidentally, but most were brought here as ornamentals or for livestock forage. These plants arrived without their natural predators of insects and diseases that tend to keep native plants in natural balance. They infest forest and rangelands, increasingly eroding land productivity, hindering land use, and management activities. They are altering native plant communities, nutrient cycling, and hydrology; they are degrading riparian areas, altering fire regimes and the intensity of wildfires, as well as disrupting recreational experiences.

In 1998, the USDA Forest Service developed an integrated strategy *(Stemming the Invasive Tide: Forest Service Strategy for Noxious and Non-native Invasive Plant Management)* for managing invasive plant species with the goal of preventing and reducing the negative impacts associated with weeds. This report both highlights and serves as a complement to that strategy. USDA Forest Service activities include prevention, early detection and rapid response, and control and management. Research, public awareness, and innovative partnerships also play an important role in effective weed management.

Integrated vegetation management programs are needed to overcome invading weeds. The Forest Service is working closely with a variety of partners, state and federal agencies, universities, natural resource managers, and private landowners to ensure successful management of weeds. The focus of the Forest Service strategy is on prevention, and it is therefore essential that we practice rapid detection and early response. This includes plants new to the United States and those that show up as satellite populations of previously established weeds. For established weeds, the Forest Service will select the highest priority areas and move to prevent weed spread and protect special interest areas which include wildlife habitats, riparian areas, research natural areas, and threatened and endangered species habitats. It is also important that we conduct appropriate research to fill in specific knowledge gaps and address land management issues.

To attain the Forest Service goal of preventing and minimizing the effects of unwanted invasive plants, we will strive to:

1. **Prevent new, unwanted introductions of weeds.**
2. **Aggressively act to eradicate new introductions before they are established.**
3. **Contain established weeds and develop restoration strategies for high priority areas.**
4. **Actively pursue research opportunities to fill the knowledge gaps Cultivate new partnerships and strengthen existing ones.**

Forest Service image 0002156. invasive.org August 22, 2003.

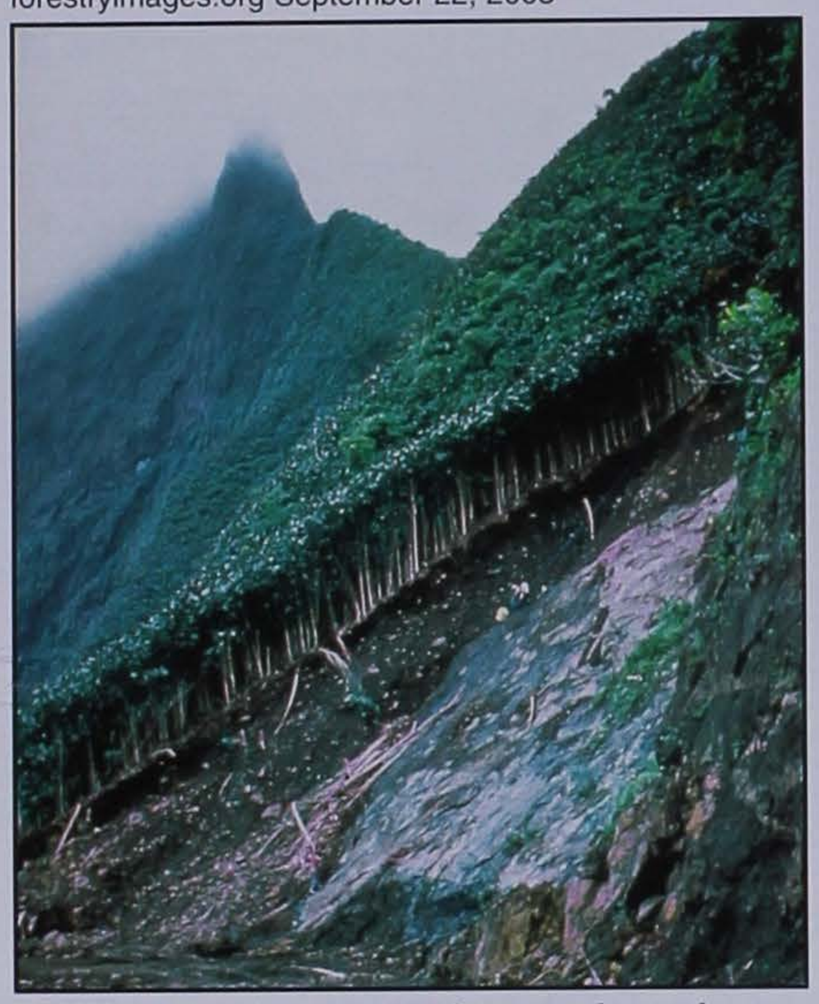
Kudzu engulfs both forests and houses. Kudzu is one of Japan's most pervasive wild plants. It was first brought to the United States as an ornamental shade plant in the late 1800s. It became a huge problem after being widely planted as forage and for erosion control from 1930s–1950s.

Forest Service image 0364060. invasive.org August 22, 2003.

Background

"Invasive plants cause several billion dollars in damages annually in the United States."

The Nature Conservancy. image 1624047
forestryimages.org September 22, 2003



Pacific island resource damage from the invasive tree miconia.

Invasive plants, otherwise known as weeds, are a serious problem in the United States, causing several billion dollars in damages annually to agricultural, forestry, recreational, and tourist industries. Plants like kudzu, mile-a-minute, and the tree-of-heaven are pushing out native wildflowers, ferns, shrubs, and trees. When this happens, the wildlife that depend on native plants for food and shelter also disappear. Weeds change the structure and chemistry of soil, alter hydrological flows and conditions, change fire regimes, and disrupt recreational experiences. They can alter native plant-pollinator systems, disrupt plant reproduction, reduce biological diversity, and cause harm to human and animal health. For example, annual exotic grasses (such as cheatgrass) have invaded many of our native grasslands and shrublands. Their presence in these plant communities has led to a buildup of fine fuels resulting in increased fire frequency. As a result, in a one week period (August '99) these fine fuels contributed to the ignition of 154 fires that burned nearly 1 million acres.

Currently, millions of acres of western rangelands are moderately to heavily infested with weeds such as cheatgrass, red brome, and medusahead. Weed invasions of rangelands reduce property values and grazing capacities. Leafy spurge, covers over 5 million acres in 29 states and has reduced land value in some places by 60-85 percent. It is estimated that the annual loss in productivity and cost of leafy spurge control, in North Dakota, Montana, South Dakota and Wyoming exceeds $144 million and has resulted in the loss of 1,400 jobs.

Approximately 4,000 species of exotic plants have established free-living populations in the United States, of which about 1/10th or 400 species threaten native flora as a result of their aggressive, invasive characteristics.

This report focuses on effective management actions that will prevent or reduce the negative impacts associated with weeds.

The challenge of managing invasive plant species is enormous. However, our integrated approach utilizing prevention, early detection and rapid response, control and management, and research can make a significant difference.

Prevention

The most effective, economical, and ecologically sound method of managing weeds is to prevent their invasion in the first place. Too often, landowners and land managers pour resources into fighting weeds after they are firmly established. In such cases, control is extremely expensive and eradication is often no longer feasible. Resources are more efficiently used in proactive weed management activities which focus on prevention of new invasions.

Preventing introductions and establishment is a top priority for the Forest Service. Once a weed population finds a favorable habitat it can grow and expand very rapidly. This leads to huge overall control costs. The longer the weed problem continues, the more expensive the remedy becomes. Once weeds have modified an ecosystem beyond a certain threshold, restoration may become impossible.

Elements of the Forest Service proactive weed prevention plan include:

- limiting weed seeds into an area;
- proper management of vegetation along roadside, trails, and waterways;
- land management practices that build and maintain healthy plant communities of native and desirable plants;
- careful monitoring of high-risk areas;
- prompt restoration of disturbed areas;
- annual effectiveness evaluations to insure the implementation of appropriate actions.

"Prevention is the most economical and ecologically sound method of managing invasive plants."

One of the more effective tools for excluding and limiting the spread of weeds into the United States is the inspection of shipments at ports of entry by the USDA Animal and Plant Health Inspection Service (APHIS). The Forest Service works closely with APHIS, State agencies, and other cooperators to develop detection and early response techniques for identifying new invasive species.

To obtain the greatest benefits, prevention should include education and communication components that inform and involve the public through enhanced understanding, acceptance, and support of the strategy. In addition, technical and financial assistance must be provided to non-industrial, private landowners to assist with prevention costs.

Powell, Dave, USDA Forest Service. image 0806092, forestryimages.org, September 2, 2003.

Scenic Strawberry Lake on the Malheur National Forest in Oregon is one of thousands of places to keep free of invasive plants.

Control & Management

(continued)

"Yellow starthistle now occupies twenty-two million acres in California."

PRESCRIBED FIRE: YELLOW STARTHISTLE

The spread of yellow starthistle in the southwest poses an increasing problem to land managers. Once established, it quickly dominates the site, out-competing native vegetation and making pastureland and rangeland unusable. It now occupies 22 million acres in California where it has become the state's most widely distributed weed. Control methods require an integrated approach using herbicide, reseeding, biological control, and fire. An ongoing study in southern New Mexico using different treatments of fire, herbicide use, and reseeding with perennial grasses is helping to determine the best combination for yellow starthistle control.

As in the case of yellow starthistle, the Forest Service promotes the integrated use of all control and management techniques. This highlights the need for continued research and development to help managers understand weed ecology and to determine effective control measures and monitoring protocols. Effective control and management are an essential part of restoring weed infestation areas.

USDA ARS. image 0022050. invasive.org. August 22, 2003.

Dewey, Steve, Utah State University. image 1299118. invasive.org, August 22, 2003.

Yellow starthistle in California forms dense stands within range and pasture lands. Prescribed fire, in association with other control methods helps control this invasive plant.

Forest Service. image 2714083. invasive.org. August 22, 2003.

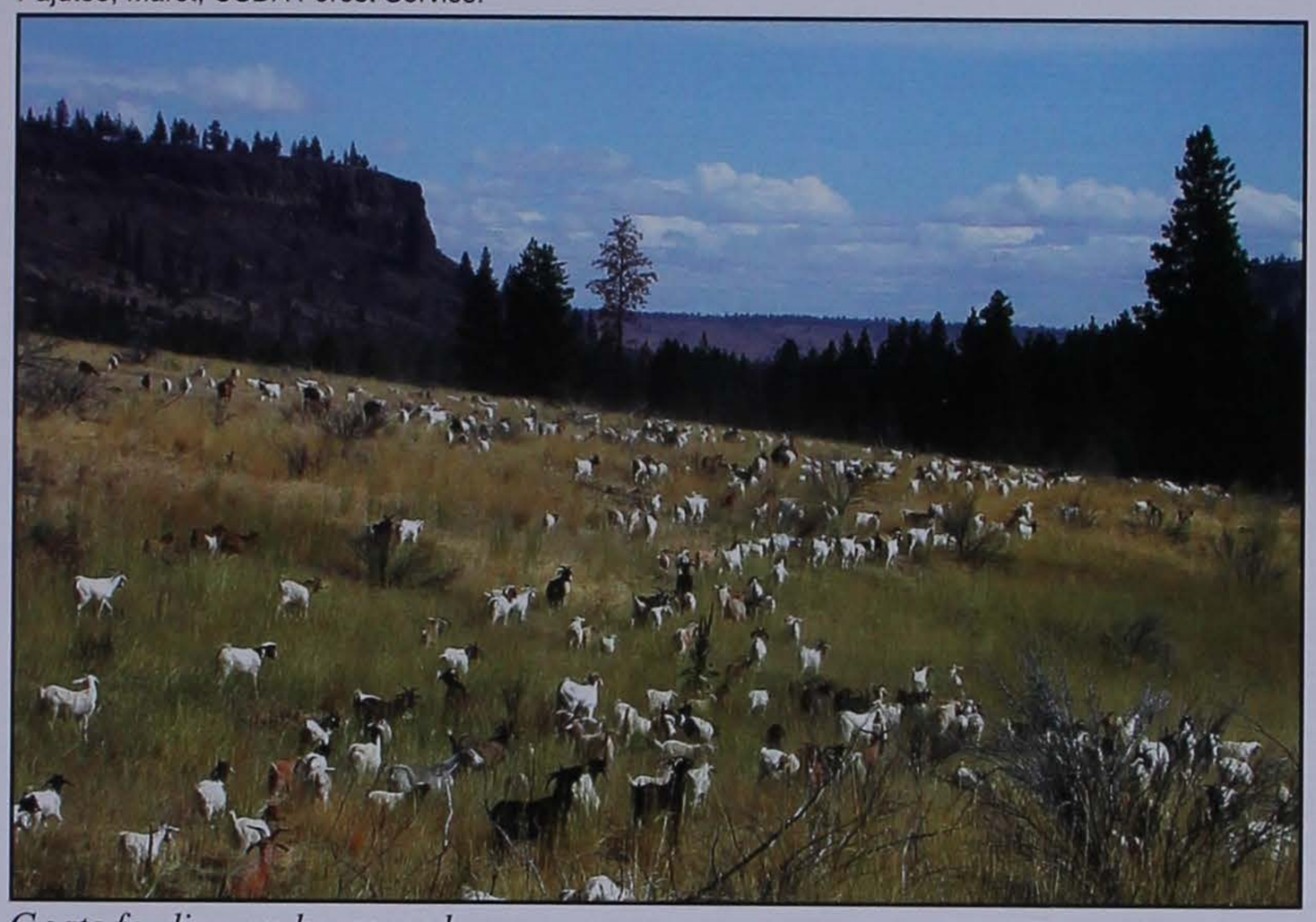
Control & Management

(continued)

GRAZING: SPOTTED KNAPWEED

The Forest Service seeks opportunities to pioneer innovative partnerships and technologies to control invasive species especially in cases where environmental concerns limit the tools available.

Pajutee, Maret, USDA Forest Service.



Goats feeding on knapweed

After the Everly fire (2002) burned 20,000 acres of the remote Fly Creek watershed the Deschutes National Forest faced an additional immediate problem: How to deal with hundreds of acres of spotted knapweed adjacent to the burn within three weeks before the knapweed began to disseminate its seed. With the cooperation of the Deschutes Soil & Water District and Caprine Restoration Services, 800 specially conditioned goats were brought in and ate most of the knapweed seed heads. This provided the necessary time needed to begin chemical and mechanical treatments in the following seasons.

Leafy spurge in flower

USDA Forest Service photo.

BIOLOGICAL CONTROL: LEAFY SPURGE

Because of its persistent nature and ability to regenerate from small pieces of root, leafy spurge is very difficult to eradicate. Several systemic herbicides have been found to be effective. Multiple treatments are necessary for several years, making leafy spurge control extremely expensive. If left uncontrolled for a single year, leafy spurge can rapidly re-infest areas.

Biological control is a promising approach for leafy spurge. Six natural enemies of the weed have been imported from Europe. These include a stem and root-boring beetle, four root-mining flea beetles, and a shoot-tip gall midge.

Federal and State officials, including the Forest Service, in many northern states cooperatively carry out large-scale field-rearing and release programs of these agents. Results are not as immediate as when herbicides are used; however, large numbers of these agents build up within a few years and have shown impressive results. These insect agents are also self-sustaining, working to control leafy spurge.

Flea beetles are a biological control for leafy spurge.

USDA ARS photo.

Forest Service scientists have been involved in the ecological assessment of the biological control agents (flea beetles) with TEAM (The Ecological Area-Wide Management of Leafy Spurge), a demonstration project funded by the Agricultural Research Service. This team is evaluating the efficacy of biological control agents by monitoring plant community recovery. Since 1998 the average reduction of leafy spurge is

Control & Management

(continued)

about 75% (range of 50–100%) on each release site. Native vegetation cover is about 40% higher than pre-release values, and species richness has increased by almost 30%.

In addition, biological control works well when used with other tools. It can be used in areas that are environmentally sensitive or difficult to access with sprayers, and often provides a great compliment to other management tools. Best of all, biological control is effective, affordable, sustainable, target specific and easy to use. Cultural and mechanical controls such as reseeding, clipping and burning are also used to give desirable grasses and other plants a competitive advantage while reducing leafy spurge's dominance.

Biological control is a critical link in suppressing the vast existing weed infestations across the country. Imported from their country of origin, such as China, over 20 varieties of fungi and insects have been identified that attack specific invasive plant species.

"Herbicides are often the only tools available to effectively control weeds."

Chemical Control

Chemical control remains a key component in a program to control weeds. The Forest Service, in cooperation with other federal agencies, has developed and evaluated many methods to manage weeds, as previously described. Generally, herbicide is used in the early stages of weed infestations as a selective tool targeting invasive plants individually. As infestations become established broadcast application of herbicide may be necessary to remove the invasive weeds and allow (often less-competitive) native plant populations time to recover on-site dominance.

Herbicides are often the only tools available to effectively control weeds. There are various application methods, from individual plant to broad scale spraying, using a variety of registered herbicides. Properly applied, they offer the possibility of eradicating target weed populations or at least of maintaining them at low levels.

Chemical control of Japanese knotweed on the Tongass National Forest in Alaska.

When used in conjunction with manual or mechanical tools or fire, herbicides often allow scientists the necessary time to research and deploy effective biological methods to control newly introduced invasive weeds. Ultimately this should minimize herbicide use by allowing the establishment of new biological balances that are ecologically acceptable and self-sustaining.

Restoration

The Forest Service emphasizes restoration to accelerate recovery of native plant communities and ensure long-term improvements in productivity, stability, and biodiversity. Restoration activities are essential in areas of special interest such as habitat for rare plants, grazing habitat, and generally to reduce the negative ecological and societal impacts associated with weed invasion.

Degraded lands have a reduced capacity to deliver ecological goods and services including biodiversity, soil, water yield and quality, forage, and the capacity to support natural fire regimes. Further degradation results in major socioeconomic as well as ecological costs.

Restoring native plant communities requires the identification and prioritization of ecosystems at risk of further degradation, an assessment of their restoration potential, and selection of specific treatments needed for restoring the ecosystem. Without proper restoration, the same or new weeds can re-infest areas.

Leafy Spurge on the Boise River of the Sawtooth National Forest.

Restoration efforts include control and management of the weeds in the infested areas in order for the process to be successful. The use of biological controls is one way to re-establish a native plant community as illustrated on the south fork of the Boise River. Other methods used for restoration are herbicide treatments, prescribed fires, and re-vegetative methods used individually or in a combination.

1997

Five hundred aphthona flea beetles being released on leafy spurge on the south fork of the Boise River, Sawtooth National Forest, Idaho.

2000

Flea beetles are well established and have suppressed leafy spurge to one fourth its previous height and prevented it from flowering over a one fourth acre area.

2002

Leafy spurge is gone and native grasses and forbs are reestablished on the hillside.

Research

Research and technology development by the Forest Service plays a key role in invasive plant prevention, control and management, and restoration. Successful control and restoration requires the development of new tools and techniques, and innovative approaches that use vegetation management tools of fire, grazing, and mechanical treatments.

Forest Service Research and Development and its university partners are working to provide better understanding of the interaction of weeds with other disturbances and their impacts on ecosystems. Additional research is needed to fill specific knowledge gaps and address management issues in the following areas:

1. Improve methods for landowners to identify which habitats are most susceptible to weed invasion, which weed species are most invasive in these habitats, and the role of disturbance in altering habitat susceptibility and weed invasiveness. By understanding these processes, managers will be able to prioritize and select habitats to work in, which weed species to control, and the most effective weed control method.

2. Clarify the interactions between weed invasion and expansion, and how land management practices, such as fire suppression, grazing, logging, road construction, and recreation affect weed proliferation.

"Successful control of invasive plants requires the development of new tools and techniques through research."

3. Information on restoration/rehabilitation potential and restoration thresholds.

4. Develop additional technologies for efficient, effective weed management that are species and site specific, based on a thorough understanding of weed biology and ecology.

5. Develop technology for predicting site susceptibility to weed establishment for the early detection program.

USDA Forest Service; image 0016265; invasive.org; August 22,2003.

Researching spray treatments on kudzu.

Conclusion

The goal of the Forest Service is to prevent and minimize the effects of unwanted invasive plant species in America's forests and rangelands. To accomplish this goal, the Forest Service will strive to:

1. Prevent new, unwanted introductions of weeds.

2. Aggressively act to eradicate new introductions before they are established.

3. Contain established weeds and develop restoration strategies for high priority areas.

4. Actively pursue research opportunities to fill knowledge gaps, cultivate new partnerships, and strengthen existing ones.

Research

Research and technology development by the Forest Service plays a key role in invasive plant prevention, control and management, and restoration. Successful control and restoration requires the development of new tools and techniques, and innovative approaches that use vegetation management tools of fire, grazing, and mechanical treatments.

Forest Service Research and Development and its university partners are working to provide better understanding of the interaction of weeds with other disturbances and their impacts on ecosystems. Additional research is needed to fill specific knowledge gaps and address management issues in the following areas:

1. Improve methods for landowners to identify which habitats are most susceptible to weed invasion, which weed species are most invasive in these habitats, and the role of disturbance in altering habitat susceptibility and weed invasiveness. By understanding these processes, managers will be able to prioritize and select habitats to work in, which weed species to control, and the most effective weed control method.

2. Clarify the interactions between weed invasion and expansion, and how land management practices, such as fire suppression, grazing, logging, road construction, and recreation affect weed proliferation.

"Successful control of invasive plants requires the development of new tools and techniques through research."

3. Information on restoration/rehabilitation potential and restoration thresholds.

4. Develop additional technologies for efficient, effective weed management that are species and site specific, based on a thorough understanding of weed biology and ecology.

5. Develop technology for predicting site susceptibility to weed establishment for the early detection program.

USDA Forest Service; image 0016265; invasive.org; August 22,2003.

Researching spray treatments on kudzu.

Conclusion

The goal of the Forest Service is to prevent and minimize the effects of unwanted invasive plant species in America's forests and rangelands. To accomplish this goal, the Forest Service will strive to:

1. Prevent new, unwanted introductions of weeds.

2. Aggressively act to eradicate new introductions before they are established.

3. Contain established weeds and develop restoration strategies for high priority areas.

4. Actively pursue research opportunities to fill knowledge gaps, cultivate new partnerships, and strengthen existing ones.

Rees, Norman, USDA ARS. image 0021012, invasive.org, September 2, 2003.

Common gorse (highlighting the spines)

Acknowledgements

Many people in the Forest Service have contributed in significant ways to this report. **Robert Mangold**, Director, Forest Health Protection Program, provided advice and general direction.

This report was prepared by a Task Force led by **Safiya Samman**, Forest Health Specialist-Geneticist, Forest Health Protection Program, Washington Office, and **Alison Hill**, Assistant Director, Rocky Mountain Research Station.

Others serving on the Task Force are:

Catherine Parks .....Research Plant Pathologist, Pacific Northwest Research Station
David Thomas .....Vegetation Management Specialist, Forest Health Protection, Washington Office
Janine E. Powell .....Assistant Director, Rocky Mountain Research Station
John W. Taylor .....Integrated Pest Management Specialist, FHP R8, Atlanta, GA
Larry Bryant .....Forest and Range Management, Washington Office
Ralph Crawford .....Research and Development VMPR, Washington Office
Wayne Owen .....National Botany Program Leader, Washington Office
Michael Shephard .....Invasive Species Coordinator, R10, Anchorage, AK
Jerry Boughton .....R10, Forest Health Protection Director, Anchorage, AK

Dewey, Steve, Utah State University. image 1299118. invasive.org, August 22, 2003.

Yellow starthistle

For additional information contact:

USDA Forest Service
State and Private Forestry
Forest Health Protection Staff
Stop Code 1110
1400 Independence Avenue, SW
Washington, D.C. 20250-1110
703-605-5344
www.fs.fed.us/foresthealth

Rees, Norman, USDA ARS. image 0021012, invasive.org, September 2, 2003.

Common gorse (highlighting the spines)

Acknowledgements

Many people in the Forest Service have contributed in significant ways to this report. **Robert Mangold**, Director, Forest Health Protection Program, provided advice and general direction.

This report was prepared by a Task Force led by **Safiya Samman**, Forest Health Specialist-Geneticist, Forest Health Protection Program, Washington Office, and **Alison Hill**, Assistant Director, Rocky Mountain Research Station.

Others serving on the Task Force are:

Catherine Parks .....Research Plant Pathologist, Pacific Northwest Research Station
David Thomas .....Vegetation Management Specialist, Forest Health Protection, Washington Office
Janine E. Powell .....Assistant Director, Rocky Mountain Research Station
John W. Taylor .....Integrated Pest Management Specialist, FHP R8, Atlanta, GA
Larry Bryant .....Forest and Range Management, Washington Office
Ralph Crawford .....Research and Development VMPR, Washington Office
Wayne Owen .....National Botany Program Leader, Washington Office
Michael Shephard .....Invasive Species Coordinator, R10, Anchorage, AK
Jerry Boughton .....R10, Forest Health Protection Director, Anchorage, AK

Dewey, Steve, Utah State University. image 1299118. invasive.org, August 22, 2003.

Yellow starthistle

For additional information contact:
USDA Forest Service
State and Private Forestry
Forest Health Protection Staff
Stop Code 1110
1400 Independence Avenue, SW
Washington, D.C. 20250-1110
703-605-5344
www.fs.fed.us/foresthealth